longer or shorter time, according to the grade of rank held by the deceased, the flesh was stripped from the bones and buried in the sea; the bones were then taken and deposited in caves or subterranean vaults, which concluded the ceremony."

Aquatic burial, so far as we yet know, was not resorted to in the United States save in exceptional instances.

In regard to the Indians previously alluded to, who disposed of their dead on Mount Coffin, Mr. Irving remarks: "The same provident care for the deceased that prevails among the hunting tribes of the prairies is observable among the piscatory tribes of the rivers and sea-coast. Among the former the favorite horse of the hunter is buried with him in the same funereal mound, and his bow and arrows are laid by his side that he may be perfectly equipped for the "happy hunting grounds' of the land of spirits. Among the latter the Indian is wrapped in his mantle of skins, laid in his canoe with his paddle, his fishing-spear, and other implements beside him, and placed aloft on some rock or eminence overlooking the river, or bay, or lake that he has frequented. He is fitted out to launch away upon those placid streams and sunny lakes stocked with all kinds of fish and water-fowl, which are prepared in the next world for those who have acquitted themselves as good sons, good fathers, good husbands, and, above all, good fishermen during their mortal sojourn."

In conclusion I would state that I have simply aimed in this paper to briefly review the different forms of sepulture of the past and present aboriginal inhabitants of the United States. The article is not intended to be exhaustive, as the subject is one which would fill several volumes were it properly treated. The examples I have selected are mostly such as are comparatively new or have not as yet attracted general attention. The graves of the ancient Pueblos of the western slope have never, I believe, been accurately described.

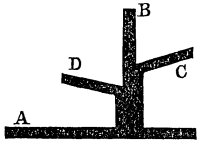
THE SLEDGE MICROTOME.

BY CHARLES SEDGWICK MINOT.

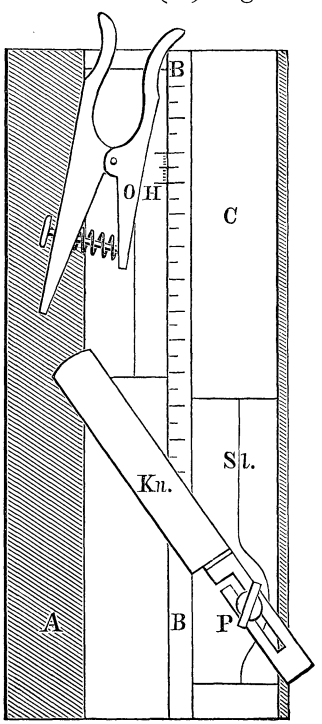
THE preparation of microscopical sections by free-hand cutting, or even with the assistance of the microtomes now in use, is accompanied by great difficulty in producing sections of even thickness. In all cases the chief trouble is caused by the irregular motion of the knife or razor which is held in the hand, and

microscopists acquire skill in cutting only by tedious practice, involving a vexatious loss of time. The instrument it is proposed to describe was invented by a French botanist to avoid this difficulty by making the guidance of the knife entirely dependent upon a mechanical construction. The instrument is so simple that two or three days suffice for learning to make sections of any desired thickness with it, while it may be used with such rapidity that hundreds of sections, all equally good, may be made in a single morning.

The instrument is made of brass, and consists of a flat, oblong base and a vertical partition (Figures 25 and 26, *B*) rising from it and running lengthwise. On each side of this partition there is a platform, that on the right-hand side (*C*) runs horizontally along the partition, and there is a sledge made to slide on it. The platform on the left-hand side (*D*) begins at one end of the partition, quite low down (Figure 25), and rises slightly but continuously as it runs along to the other end of the partition, Figure 26 (*B'*). This platform carries a sledge furnished with a clamp to hold the object to be cut. Both the platforms are oblique, as may be seen in Figure 25, so as to form together with the partition a sort of groove which is sufficient to guide the motion of the sledges perfectly. The principle of the instrument is, that the object is shoved up an inclined plane on the left-hand side, and is thereby raised. Then the knife, fastened to the sledge on the right-hand platform, is drawn back, and cuts through the object, which is then shoved a little further up the inclined plane, and the knife when drawn across cuts again in a plane parallel to that of the first cut, and thus a slice with two parallel surfaces is removed. Of course the thickness of the section is determined by



(Fig. 25.)
End view, $\frac{1}{3}$, without the sledges.



(Fig. 26.)
View from above, $\frac{1}{2}$.

the distance the object is moved up the inclined platform between the first and second cuts.

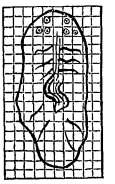
Figure 26 represents the microtome as seen from above, one half the natural size. *A*, which is shaded, represents the base; *BB'* is the top of the partition, and is marked off into millimeters, though only the centimeters are represented in the cut; on the right is the horizontal platform *C*, while the sledge (*Sl*) is represented lying on it; the sledge is provided with a screw pin (*P*) for fastening the knife, the handle of which is provided with a slot into which the pin may be slipped; the knife (*Kn*) is placed obliquely, as seen in the figure, so as to project over the other side of the partition. The sledge is made so high that the knife lies above the top of the partition. On the left-hand side of the partition is the inclined platform *D*, carrying the sledge or object holder *OH*. This carries a clamp shaped very much like one of the patent clothes-pins now so much in vogue for hanging up maps and diagrams. The object to be cut must be imbedded in paraffine or soap; it is then placed between the front arms of the clamp, where it is held tightly by the action of a spiral spring between the hind arms (compare Figure 26), so arranged as to press the front arms together.

The object holder must be slid down and the knife sledge pushed forward, and the first cut may be made by pulling the knife back. After making the cut the object is again shoved up the inclined platform a little way; the exact distance may be determined by means of the scale on the top of the partition *BB'*. The inclination of the platform is such that the slice cut off is in thickness one twentieth of the distance which the object has been shoved forward, that is, the rise is one in twenty, so that if the object be moved forward 1 m.m. the section will be $\frac{1}{20}$ m.m., and so on.

No sooner has one section been cut off than another may be made, which will be exactly parallel to the first. In this way a long object can be cut into very thin sections, all equally good, and exhibiting every part of the body cut. Now, suppose a small worm to be cut in this way into transverse sections, we could examine first the head and then the successive portions of the body. I have frequently made long series of such sections, and have found them to afford a surer means of studying the anatomy of minute opaque animals than any other I know of, for in this way every portion of the animal may be subjected to minute examination, and, further, the sections once made and mounted they

may be stowed away and investigated at any leisure moment. For example, during a few weeks at the seaside, material for a winter's occupation may be very easily procured. Neither is there so much hurry in drawing, as when an animal is living we are afraid it may die. For the sake of controlling the observations made on the sections, sketches of the general structure may be made, thus enabling the student to remember where each particular section must have come from.

There, is however, one other consideration to be noted, namely, that every cut destroys a certain amount of tissue. Thus suppose that a worm, as in Figure 27, be cut transversely, a good deal will be destroyed; but if longitudinal sections be made of another specimen, then one will see parts that the cut destroyed before, and only those spots where the two sets of cuts would have crossed had they been on the same animal will be wanting in both series. But even if you merely make a second series of cuts they will not destroy exactly the same place as in the first series.



(FIG. 27.) Longitudinal and transverse sections, the lines showing the cuts.

When only a few preparations of some tissue are wanted, this instrument permits a rapidity of work combined with a degree of nicety unattainable by any other means, and I do not hesitate to recommend it most highly both to those who are carrying on microscopical investigations and those who are forming amateur collections, for only a little care is requisite to enable even persons with unskillful or unpracticed hands to make preparations equal to the very best that have ever been produced.

To succeed in doing this, however, very great care must be paid to the way of preparing the object. The following method is applicable in a great many cases, in all, in fact, except where there is any fat to be preserved, or where, as is not unfrequently the case in histology, a special method of hardening or staining has to be employed: If the object is some small animal it may be killed by putting it in an 0.1% osmic-acid solution or in picric acid, and then in alcohol for twenty-four hours or less, according to the size of the object, and finally in absolute alcohol in sufficient quantity to entirely remove all the water from the object. For this purpose thirty or forty times the volume of the object is necessary. If the object is a bit of tissue or some organ it may be hardened in alcohol without any preliminary treatment. When the object is composed of loose tissue, and is not more than 3 m.m. in diameter, it may be colored *in toto*, thereby sav-

ing a great deal of labor. This is done by putting it after it has been in absolute alcohol in a very weak carmine or hæmatoxyline solution. Either of these may be prepared by diluting the ordinary tinctures (Beale's carmine or Bœhmer's hæmatoxyline) with about six times their volume of distilled water. Carmine usually gives the best results. The object must be left from twelve to twenty-four hours in the coloring solution, according to its size and nature, and then replaced in absolute alcohol for twenty-four hours.

It is sometimes convenient to use chromic acid for hardening tissues a little before putting them in the alcohol. In this case they cannot be easily colored *in toto* unless every trace of the chromic acid has been removed by frequently renewing the absolute alcohol, a troublesome process requiring a long time and large quantities of spirit.

The object once hardened, or colored and hardened, as the case may be, can be imbedded in paraffine by the following method: Place it in pure turpentine for half an hour, then five or ten minutes in a mixture of equal parts of paraffine and turpentine by weight, warmed so as to be liquid, and afterwards in pure, melted paraffine for five minutes. Great care must be taken not to have the paraffine warmer than is necessary to keep it liquid, otherwise the tissues will be ruined. The object should be moved about gently in the paraffine to free it from the turpentine adherent to its surface. By these processes the paraffine penetrates the whole object, giving it the best consistency possible for cutting.

The next step is to pour some paraffine into a little paper tray, then lay the object in it, and pour in enough paraffine to cover it over entirely, and leave it for half an hour or more to cool. The mass of paraffine, when solid, may be taken out, and trimmed down with a penknife to such a size and shape as will let it fit into the clamp of the object holder of the microtome; the part containing the object must project enough above the clamp to be struck by the knife as it is drawn along, in the way above described.

When the object contains fatty tissue which it is wished to examine more closely, it may be imbedded in the so-called transparent glycerine soap in the way that has already been in use for several years.

The sections when made are surrounded by paraffine, and usually curl up. They must be taken up with a fine-pointed brush,

barely moistened with spirits of turpentine, and then put on a slide and covered with a drop of turpentine, which dissolves in a few seconds all the paraffine. The sections can then be unrolled with the brush. If the object is colored *in toto*, the sections are all ready for mounting, which may be done by wiping off the superfluous turpentine with a bit of cambric. The addition of a drop of balsam (or better still of a mixture of one part Canada balsam and two parts white Dammar varnish) and putting on a cover slip complete the preparation.

If, however, the object has not been colored beforehand, the sections must be stained singly; to do this, when they have been imbedded in paraffine they must be left half an hour in a few cubic centimeters of spirits of turpentine, then one fourth of an hour in absolute alcohol, after which the alcohol should be renewed and the sections left for another quarter of an hour, whereupon they can be at once stained and mounted either in balsam or glycerine in the usual manner described in all hand-books of microscopy or histology.

This method of imbedding in paraffine has the great advantage that objects once prepared in this way may be kept indefinitely and be cut at any time, or even be partially cut, and then be stowed away to be cut again by and by, it being only necessary to cover up the exposed surface of the object by dropping a little melted paraffine upon it. I have a small collection of such objects, each one bearing a number referring to a catalogue, so that there are several things of which I can make a first-rate preparation in ten minutes at any time.

I have found it convenient in making long series of sections to designate each series by a letter of the alphabet, and after having been once through to begin anew AA, AB, AC, and then again BA, BB, BC, and so on, I am accustomed to put several sections on each slide, which are numbered. My catalogue shows what each series is, and also anything about any section I choose to note, thus: "W. Planaria tora, transverse sections, 2 (slide number) through the brain, III. (number of section) through the eyes. In this way any particular section out of many thousands can be quickly found.

The sledge microtome can be obtained of Thomas A. Upham, mechanician, 17 Harvard Place, Boston, Mass., for $25. The knives have, at present, to be imported from Windler, Dorotheenstrasse 3, Berlin C, where they cost 6 marks (2 thalers) apiece. But Mr. Upham hopes soon to be able to supply knives himself.